USTH – ICT department – Teaching Unit 1.3

Systems and Networks

Acedemic year 2011-2012

Session 2

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Duration: 1h30 – Documents are not accepted during the exam

Question 1

In this question, we rely on Hoare monitors as presented in the lectures (this means priority to the signal receiver and implicit locking of the monitor).

You must program a monitor which implements a producer-consumer scheme (as explained in the lectures). This monitor called *ProdCons* provides two procedures:

- *void produce(Item it);*
- *Item consume();*

The number of places in the buffer is a constant *N* and the two above procedures rely on the two following procedures to effectively manage the buffer (you don't have to implement the code which manages the buffer).

- void effective_production(Item it);
- Item effective_consumption();

You have to implement *ProdCons* with ONE AND ONLY ONE condition variable.

Question 2

In this question, we use Semaphores as presented in the lectures.
We consider two computation processes P1() and P2() that we launch in parallel (on a multi-core architecture). A third process Display(), which shows the results of the computations, should start only when P1() and P2() completed their computations.
Describe the code (using Semaphores) that you must add to P1(), P2() and Display() in order to implement this synchronization scheme.

Question 3

We consider a page replacement system for virtual memory management in an operating system.
We assume that the physical memory is composed of 4 pages.
The first line of the table below gives the numbers of the virtual pages which are consecutively accessed.
The first column of the table gives the physical page numbers associated with each line.
Physical pages are initally empty.
Each column corresponds to an access to a virtual page and gives the state of physical memory after the access.
You have to give such a table in three cases:

- when a FIFO strategy is used
- when a LRU (Least Recently Used) page replacement strategy is ued
- when the optimal strategy is used

For each case, indicate the number of page faults.

Access to page	1	2	3	4	1	2	5	1	2	3	4	5	2	3
Page 1														
Page 2														
Page 3														
Page 4														

Question 4

You have to implement a simple client/server example which behaves as follows:

- the server waits for incoming connections (forever). When a connection is initiated, it receives a number (simply a char) and returns that number incremented by 1.
- the client initiates a connection to the previous server. It sends a number and receives the result.

These two programs (server.c and client.c) must be programmed in C, using socket and the TCP protocol.

You can assume that you have a variable: *struct sockaddr_in ad;*
which is already filled on both side, with the IP address and port of the server.

System calls that may be useful

```
int socket(int domain, int type, int protocol);
int connect(int sockfd, const struct sockaddr *addr, socklen_t addrlen);
int bind(int sockfd, const struct sockaddr *addr, socklen_t addrlen);
int listen(int sockfd, int backlog);
int accept(int sockfd, struct sockaddr *addr, socklen_t *addrlen);
ssize_t read(int fd, void *buf, size_t count);
ssize_t write(int fd, const void *buf, size_t count);
int close(int fd);
```